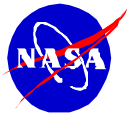
SPACE SHUTTLE PROGRAM
Space Shuttle Program Integration
NASA Johnson Space Center, Houston, Texas



STS-109 Flight Readiness Review

February 14, 2002

Agenda

- Program Integration – Mission Director — Phil Engelauf
  - Key Program Considerations
  - Payload Topic
    - Hubble Space Telescope Status — Preston Burch
  - Payload & System Safety *
  - Orbital Debris Status * — No Issues
  - Payload In-Flight Anomalies — No Issues
  - Launch Commit Criteria * — No Issues
- USA Program Integration *
- Boeing Integration
  - Waivers to Vol X — No Issues
- System Integration TMR *
- Flight Readiness Statement

* Backup Material Included

Key Program Considerations

- **First flight of Columbia / OV-102 after OMDP**
  - **Significant new installations:**
    - **Multifunction Electronic Display System (MEDS)**
    - **Wireless Video System (WVS)**
  - **No issues**
- **HST SM-3B is the most challenging HST mission to date**
  - **Most aggressive cumulative EVA plan attempted**
  - **Joint ground teams and crew very experienced and extensively trained**

Goddard Space Flight Center

HST Program Status

Flight Readiness Review

Preston M. Burch
Code 440
February 14, 2002

HST Flight Readiness Summary

- All HST SM3B hardware is at KSC and ready to fly, with the exception of the Reaction Wheel Assembly (RWA)
- All HST Ground System testing completed except for:
  - Pad end-to-end testing scheduled for later this month
  - Verification of minor changes to command plan (CP)
- All Flight Software testing completed, with exception of minor changes to two macros
- Training of HST personnel is 100% complete, personnel and facilities are ready
  - Integrated training has demonstrated excellent team communications
- HST flight execution products are ready for both nominal and contingency scenarios, except for above-mentioned CP changes
- HST is ready to fly, pending completion of final processing at the pad

Reaction Wheel Assembly

- Reaction Wheel Assembly (RWA) added to manifest in December
  - RWA1 experienced 7 minutes of anomalous operation; experts concluded wheel will likely get worse and fail
  - One RWA failure makes HST zero-fault-tolerant to additional RWA problems
- Two flight spare RWAs removed from storage for re-certification
  - Functional, vibration, thermal vacuum and Ground System testing
  - RWA SN1007 experienced 3 non-commanded shutdowns attributed to Ground Support Equipment, but not conclusively proven
  - RWA SN1009 successfully completed formal re-certification
  - RWA SN1009 undergoing additional testing to bring it closer to level of testing achieved with RWA SN1007

Reaction Wheel Assembly (cont'd)

- Large ORU Protective Enclosure (LOPE) re-configured and certified to carry wheel
  - Items previously stored in LOPE moved to mid-deck, or removed from the flight (spare PRT)
- LOPE and RWA SN1007 delivered to KSC on January 29 and installed on carrier January 30
- February 11 Flight Assurance review of RWA SN1007 non-commanded shutdowns resulted in a recommendation not to fly RWA SN1007
  - If further ground testing of RWA SN1009 conclusively proves that GSE caused non-commanded shutdowns, then RWA SN1007 will be cleared for flight
  - Otherwise, RWA SN1009 will be installed in the LOPE at the launch pad on February 16
- RWA will be installed in HST during EVA 2, following replacement of second solar array

HST Flight Hardware Status

- All other HST replacement hardware is fully tested, certified, and ready to fly
  - Solar Array 3
  - Power Control Unit
  - Advanced Camera for Surveys
  - NICMOS Cooling System
- Carriers fully tested and certified, ready to fly pending completion of end-to-end test and final closeouts at the pad
  - Rigid Array Carrier (RAC)
  - Second Axial Carrier (SAC)
  - Flight Support System (FSS)
  - Multi-Use Lightweight Equipment Carrier (MULE)
- HST provided EVA Crew Aids and Tools fully certified and ready to fly

Ground System and Flight Software Summary

- **Completed all planned Flight Software and Ground System development, test, and verification**
- **All Flight Software and Ground System elements are frozen in launch configuration**
- **Recent discovery of an operational limitation in the Solar Array Drive Electronics (SADE) that is associated with the Solar Array 3 Diode Boxes requires additional safeguards in two Flight Software macros and the Command Plan**
  - **Changes are minor and easy to implement, but they must be thoroughly verified**
  - **Changes will be completed and verified by February 20**
- **All HST mission operations facilities are certified and ready for flight (both primary and backup)**

Open Work

- Closeout of final VTL items
- Pad processing leading to final payload closeout and launch
- Install RWA SN1009 into the LOPE
- Implement and verify minor changes to two Flight Software macros and the Command Plan

HST Program Manager Assessment

- HST is ready to fly upon completion of remaining planned work

HST SM-3B EIRR Report

Flight Readiness Review

George D. Nelson, EIRR Chair

February 14, 2002

EIRR Team

- George D. Nelson, chair
- Steven Battel
- Harold Draughon
- Edward G. Gibson
- Richard Harms
- Hal Lambert
- John Mangus
- Ann Merworth
- Robert Skelton
- Pierre J. Thuot
- Christina Alvarado, JPL, Exec Asst/Rec Secretary

EIRR Charter

- Provide NASA management with independent assessment of flight readiness and mission risk
  - Review Integration, Test and Verification of New Instruments and Manifested Hardware
  - Review Planning and Preparation for On-orbit Servicing and Verification of HST
  - Special Issues and Concerns
- Report findings and issues to HQ Code S, HQ Code M, JSC SM-3B Mission Manager, GSFC Associate Director For Flight Projects

One Open Action Item

- RWA replacement hardware decision
  - Steve Battel will review data and decision at GSFC 2/15/02
  - EIRR telecon scheduled 2/20/02
- Preliminary analysis supports decision to fly RWA 1009
  - Testing has been clean
    - No unexplained anomalies
    - Break-in bearing noise larger than normal, but acceptable
    - Operating torque within limits

Summary

- IVT for all manifested hardware successfully completed (except RWA 1009)
  - Pending successful resolution of open action item on RWA
- Mission planning and preparation for on-orbit servicing and verification successfully completed
- With positive resolution of RWA action item, the EIRR finds that the HST SM-3B mission is ready to fly
- EIRR final report to be submitted on 2/21/02

Payload and System Safety

- **Four Non-Compliance Reports (NCR's) Are Approved**
  - **Deviation - PGT not two fault tolerant to undetected, insufficient torque when used with safety critical fasteners**
    - **Torque Comparators verified during initial activation**
    - **Periodic cycling through test calibration**
    - **Crew trained to recognize under-torque condition**
    - **No safety-critical uses on STS-109**
  - **Deviation - Some HST hardware does not meet EVA requirements related to impact or temperature extremes**
    - **Cold temperature concerns mitigated by heated gloves**
    - **Crew training to avoid uncontrolled contact**

Payload and System Safety

- **Non-Compliance Reports (NCR's) (Continued)**
  - **Waiver – HST payload complement does not clear payload bay doors in the event of rapid safing situation (Need 32 minutes to safe compared to 20 minutes required)**
    - **Small exposure to violation**
    - **During EVA's 1 and 2 for about 35 minutes (worst case)**
    - **Crew has trained for rapid safing**
  - **Waiver - EVA crew demating / mating of electrical connectors do not meet isolation requirements (9 hot connectors, 34 non-compliant connectors)**
    - **Downstream loads inhibited or minimized for hot connections**
    - **Upstream power source isolated for non-compliant connections**
    - **Scoop-proof connectors**
    - **Crew training**

STS-109 Flight Readiness Statement

THIS CERTIFIES THAT ALL MISSION REQUIREMENTS HAVE BEEN MET AND SPACE SHUTTLE INTEGRATION IS READY FOR FLIGHT, PENDING COMPLETION OF THE DEFINED OPEN WORK

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SPACE SHUTTLE SYSTEMS INTEGRATION

/s/ Michele A Brekke

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/s/ Philip L Engelauf

P. L. ENGELAUF, MISSION DIRECTOR
SPACE SHUTTLE PROGRAM INTEGRATION

STS-109 Flight Readiness Review

Backup Charts

Payload and System Safety

- Toxicology Process – Not Required
- Payload Safety Review Process Is Complete

STS-109 Orbital Debris Status

- **Orbital Debris / Micrometeoroid Risk Is Acceptable**

Criteria	Risk	Guideline
Critical Penetration	1 in 365	1 in 200
Radiator Tube Penetration	1 in 192	1 in 61
Window Replacements	80.9%	N/A

Launch Commit Criteria Changes for STS-109

- **STS-109 Minimum Equipment List (MEL) Mission Dependent**
- **Haz Gas Update for HGDS 2000 Hardware Mods**
  - **Update of the Has Gas Section and Figures in support of the newly installed Has Gas 2000 hardware**
- **Modular Memory Unit Required Changes**
  - **Modifies existing requirements for the new Solid State Modular Memory Unit which replaces both the current Mass Memory Unit (MMU) and the OPS / Payload Recorder**
  - **New SSID has been added for Comprehensive Self Test requirements for the SSMMU**
- **GNC-73 Update to Req, PCP, and Redline**
  - **Requirements have been rewritten to delete the Hex word associated with simultaneous Input Good and A-D Converter Good bits set and now have unique procedures for both Input Good bit and A-D Converter Good bit**

Launch Commit Criteria Changes for STS-109

- **AC Bus Voltage Drop**
  - Current LCC only allows for single phase measurement loss. Requirements have been rewritten such that no phase measurements are mandatory as long as acceptable phase voltage can be verified using panel meter
- **Modification of Tracking Data Requirements**
  - Mandatory coverage is being decreased from 450 seconds to 440 seconds for 49 degree and 51.6 degree inclinations. With this change, range safety operations can support solely from the KSC launch area with no increase to public risk

USA PROGRAM INTEGRATION FLIGHT PREPARATION PROCESS

Presenter:
Bob White
Organization/Date:
Program Integ/01-14-2002

- **All the Systems and Cargo Integration flight preparation activities have been completed except for planned open work – no issues identified**

- **Completed tasks include:**
  - Verification of compliance with generically certified requirements
  - Mission specific analyses
  - Documentation of vehicle and cargo requirements
  - Reconfiguration / installation of Payload Integration hardware
  - Payload bay clearance assessment

Program Integration Is Ready to Support Flight

STS-109 NASA System Integration TMR Flight Readiness

- Insight, audit and surveillance requirements complete
- No out-of-family problems have been identified for impact to safety of flight, or planned flight operations
- Approved Program requirements changes have been implemented and verified
  - ICD, OMRS, LCC
  - Vehicle configuration
  - DOSS configuration
  - NSTS 07700, Volume X
- System Integration is ready for flight pending the completion of remaining open work